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Reply to Office Action of September 12, 2006

## REMARKS

### Status of Claims

Claims 1, 2, 7-8, 10, 12-14 and 16 are previously presented; claims 3-6, 9, 11 and 15 are remained unchanged.

### Claim Rejections - 35 USC §103

Claims 1, 3-5, 13, and 15 are rejected under 35 U.S.C. 103(a) as being unpatentable over Park et al. (US 20030027478) in view of Applicants' admitted prior art.

In response thereto, Applicants respectfully traverse the rejection of such claims and assert that the rejected claims are patentable.

Claim 1, as previously presented, recites in part:

...providing a substrate having a flat surface;  
...forming a carbon nanotube array extending from the selected area, the carbon nanotube array having a flat bottom surface corresponding to the flat surface of the substrate;  
forming a cathode electrode on a top of the carbon nanotube array;  
and  
removing the substrate so as to expose the flat bottom surface of the carbon nanotube array so that the flat bottom surface of the carbon nanotube array is thereby configured for acting as an electron emitting surface of the carbon nanotube-based field

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emission device. (Emphasis added.)

Applicants submit that the method as set forth in previously presented claim 1 is neither taught, disclosed, nor suggested by Park et al. '478, Applicants' admitted prior art, or any of the other cited references, taken alone or in combination.

Park et al. '478 discloses a method of making a field emission display. As shown in FIGs. 2A-3D and Paras. [0021]-[0031] of Park et al. '478, the method includes the following steps:

- forming a cathode on a substrate;

- forming a gate insulation layer having a plurality of gate holes on the cathode;

- forming a gate electrode having a plurality of via-holes corresponding to the gate holes, respectively, on the gate insulation layer;

- forming a plurality of conductive columns higher than the gate electrode on the cathode with the respective gate holes;

- adhering the CNTs to the bottom of a plate template which is separately provided;

- bringing the bottom of the template having the CNTs to contact the tops of the conductive columns to adhere the CNTs to the tops of the conductive columns; and

- firing the conductive columns to lower the levels thereof.

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As shown in Paras. [0011] and [0028], the CNTs may be formed on the bottom of the template by a growth method or may be adhered to the bottom of the template in a state of purified powder which is separately produced. Furthermore, as shown in Para. [0030], it is clearly stated that the CNTs are actually adhered on the bottom of the template in a state of disorder. Thus, the CNTs in Park et al. '478 are actually not aligned in an array, as required in previously presented claim 1.

Furthermore, there is no specific disclosure or suggestion in the method of Park et al. '478 that the template has a flat surface and, moreover, that the CNTs have a flat bottom surface corresponding to the flat surface of the template. Further, Park et al. '478 does not recognize the problem solved by expressly requiring such flat surfaces, i.e., how to achieve improved electron emission uniformity and device stability. Thus, Park et al. '478 fails to teach or suggest every element in claim 1, as previously presented.

Therefore, previously presented claim 1 clearly recites novel and unobvious physical subject matter over any proposed combination of Park et al. '478 and Applicants' admitted art. Applicants submit that the novel and unobvious physical features of previously presented claim 1 produce new and unexpected results over and above Park et al. '478, Applicants' admitted art or any of the other cited references, taken alone or in combination. The new and unexpected results achieved with the claimed method are associated with the exposed flat bottom surface of the carbon nanotube array. The exposed flat bottom surface of the carbon nanotube array acts as an electron emitting surface of the device. Thus, this flat surface effect improves electron emission uniformity and stability of the manufactured device and

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thus helps to overcome the shortcoming of the prior device manufactured by the prior method whose electron emitting surface is neither predictable nor controllable (see Paras. [0003], [0006]). Applicants' invention is therefore clearly superior to that of any one of Park et al. '478 or Applicants' admitted art, or any proposed combination thereof. The novel features of Applicants' invention, which give effect to these results, are clearly recited in previously presented claim 1.

Therefore, it would not have been obvious to one of ordinary skill in the art to combine Park et al. '478 and Applicants' admitted art to embody and disclose the present invention as set forth in previously presented claim 1.

Dependent claims 3-5, respectively, incorporate all the subject matter of independent claim 1 and add respective additional subject matter. As detailed above, it is asserted that claim 1 is allowable. Thus, it is submitted that the dependent claims 3-5 are also allowable, and Applicants request that the rejection relating thereto be removed.

Claim 13, as previously presented, recites in part:

...providing an insulative substrate having a flat surface;

forming a carbon nanotube array extending from a selected area of the flat surface, the carbon nanotube array having a flat bottom surface corresponding to the flat surface of the insulative substrate;

depositing a layer of metallic material on a top of the carbon nanotube array; and

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removing the insulative substrate to expose the flat bottom surface of the carbon nanotube array so that the flat bottom surface of the carbon nanotube array is thereby configured for acting as an electron emitting surface of the carbon nanotube-based field emission device.  
(Emphasis added.)

Applicants submit that the method as set forth in previously presented claim 13 is neither taught, disclosed, nor suggested by Park et al. '478, Applicants' admitted prior art, or any of the other cited references, taken alone or in combination.

For reasons similar to those asserted above in relation to the rejection of claim 1 under 35 U.S.C. § 103 on Park et al. '478 in view of Applicants' admitted prior art, Applicants submit that subject matter as set forth in previously presented claim 13 is neither taught, disclosed, nor suggest by Park et al. '478, Applicants' admitted prior art, or any of the other cited references, taken alone or in combination.

Therefore, it would not have been obvious to one of ordinary skill in the art to combine Park et al. '478 and Applicants' admitted prior art to embody and disclose the present invention claimed in previously presented claim 13.

Dependent claim 15 incorporates all the subject matter of independent claim 13 and adds respective additional subject matter. As detailed above, it is asserted that claim 13 is allowable. Thus, it is submitted that the dependent claim 15 is also allowable, and Applicants request that the

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rejection relating thereto be removed.

**Claims 2, 14, and 16 are rejected under 35 U.S.C. 103(a) as being unpatentable over Park et al. (US 20030027478) in view of Applicants' admitted prior art and in further view of Mirkin et al. (US 20030049381).**

Dependent claim 2 incorporates all the subject matter of independent claim 1 and adds respective additional subject matter. As detailed above, it is asserted that claim 1 is allowable. Thus, it is submitted that the dependent claim 2 is also allowable, and Applicants request that the rejection relating thereto be removed.

Dependent claims 14 and 16, respectively, incorporate all the subject matter of independent claim 13 and add respective additional subject matter. As detailed above, it is asserted that claim 13 is allowable. Thus, it is submitted that the dependent claims 14 and 16 are also allowable, and Applicants request that the rejection relating thereto be removed.

**Claim 6 is rejected under 35 U.S.C. 103(a) as being unpatentable over Park et al. (US 20030027478) in view of Applicants' admitted prior art and in further view of Dai et al. (US 6,232,706).**

Dependent claim 6 incorporates all the subject matter of independent claim 1 and adds respective additional subject matter. As detailed above, it

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is asserted that claim 1 is allowable. Thus, it is submitted that the dependent claim 6 is also allowable, and Applicants request that the rejection relating thereto be removed.

**Claim 7 is rejected under 35 U.S.C. 103(a) as being unpatentable over Park et al. (US 20030027478) in view of Applicants' admitted prior art and in further view of Hsu (US 20020042241).**

Dependent claim 7 incorporates all the subject matter of independent claim 1 and adds respective additional subject matter. As detailed above, it is asserted that claim 1 is allowable. Thus, it is submitted that the dependent claim 7 is also allowable, and Applicants request that the rejection relating thereto be removed.

**Claims 8 and 12 are rejected under 35 U.S.C. 103(a) as being unpatentable over Park et al. (US 20030027478) in view of Mirkin et al. (US 20030049381).**

In response thereto, Applicants respectfully traverse the rejection of such claims and assert that the rejected claims are patentable.

Claim 8, as amended, recites in part:

...providing a substrate having a surface which has a variation in flatness of less than 1 micron;

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forming a carbon nanotube array extending from a selected area of the surface of the substrate, the carbon nanotube array having a flat bottom surface corresponding to the flat surface of the substrate;

forming a cathode electrode on a top of the carbon nanotube array;  
and

removing the substrate so as to expose the flat bottom surface of the carbon nanotube array so that the flat bottom surface of the carbon nanotube array is thereby configured for acting as an electron emitting surface of the carbon nanotube-based field emission device.  
(Emphasis added.)

Mirkin et al. discloses a lithographic method referred to as "dip pen" nanolithography (DPN). DPN utilizes a scanning probe microscope (SPM) tip as a "pen", a solid-state substrate as "paper" and a patterning compound as "ink". The tip is coated with the ink and is contacted with the substrate so that the ink is applied to the substrate by capillary transport to produce a desired pattern (see Para. [0011]). As shown in FIG. 2D and Para. [0142] of Mirkin et al., smoother and more contiguous lines could be drawn by increasing the line width to 100 nm or by using a smoother substrate.

It is clear that the substrate in Mirkin et al. is used to have the ink deposited thereon but not to have carbon nanotube array formed therefrom. Furthermore, "100 nm" actually refers to the drawn line width, not to any particular variation in flatness of the surface of the substrate. Thus, Mirkin et al. fails to teach or suggest every element in claim 8, as previously presented, and is unable to overcome the shortcomings of Park et al. '478,



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set forth above (e.g., with respect to the flatness limitations for the substrate and the corresponding bottom surfaces of the CNT's; and/or the formation of an array of CNT's instead of a disordered grouping).

For reasons similar to those asserted above in relation to the rejection of claim 1 under 35 U.S.C. § 103 on Park et al. '478 in view of Applicants' admitted prior art, Applicants submit that subject matter as set forth in previously presented 8 is neither taught, disclosed, nor suggest by Park et al. '478, Mirkin et al., or any of the other cited references, taken alone or in combination. Moreover, Applicants submit that the novel and unobvious physical features of previously presented claim 8 produces new and unexpected results over and above Park et al. '478, Mirkin et al., or any of the other cited references, taken alone or in combination. Applicants' invention is therefore clearly superior to that of any one of Park et al. '478 or Mirkin et al., or any proposed combination thereof. The novel and unobvious features of Applicants' invention, which give effect to these results, are clearly recited in previously presented claim 8.

Therefore, it would not have been obvious to one of ordinary skill in the art to combine Park et al. '478 and Mirkin et al. to embody and disclose the present invention claimed in previously presented claim 8.

Dependent claim 12 incorporates all the subject matter of independent claim 8 and adds respective additional subject matter. As detailed above, it is asserted that claim 8 is allowable. Thus, it is submitted that the dependent claim 12 is also allowable, and Applicants request that the rejection relating thereto be removed.

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**Claims 9 and 11 are rejected under 35 U.S.C. 103(a) as being unpatentable over Park et al. (US 20030027478) in view of Mirkin et al. (US 20030049381) and in further view of Applicants' admitted prior art.**

Dependent claims 9 and 11 incorporate all the subject matter of independent claim 8, respectively, and add respective additional subject matter. As detailed above, it is asserted that claim 8 is allowable. Thus, it is submitted that the dependent claims 9 and 11 are also allowable, and Applicants request that the rejection relating thereto be removed.

**Claim 10 is rejected under 35 U.S.C. 103(a) as being unpatentable over Park et al. (US 20030027478) in view of Mirkin et al. (US 20030049381) and in further view of Smalley et al. (US 6,183,714).**

Dependent claim 10, incorporates all the subject matter of independent claim 8 and add respective additional subject matter. As detailed above, it is asserted that claim 8 is allowable. Thus, it is submitted that the dependent claim 10 is also allowable, and Applicants request that the rejection relating thereto be removed.

### ***Conclusion***

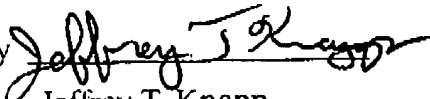
For all the above reasons, applicants assert that all the pending claims are now in proper form and are patentably distinguishable over the prior art. Therefore applicants submit that this application is now in condition for

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allowance, and an action to this effect is earnestly requested.

Applicants further note that any new rejection in the next Office Action of any of the pending claims could not be considered as having been necessitated by amendment. Accordingly, Applicants respectfully submit that such an Office Action should not be made FINAL, based upon the guidelines set forth in MPEP §706.07(a).

Respectfully submitted,  
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